

Levee System Integrity Program

Levee Program Objectives

The goal of the Levee Program is to provide long-term protection for multiple Delta resources including, water quality, life and property, agriculture, water system reliability, and habitat. These objectives are met through the Levee Program by maintaining and improving the integrity of the extensive Delta levees system. The Levee Program is organized into three following task groups:

- **Levee Maintenance** – DWR provides funding to Reclamation Districts to reimburse their ongoing levee improvement actions
- **Levee Improvements** – CALFED agencies provide funding to participating local agencies to improve all Delta levees to a base level of protection equal to the PL 84-99 Delta-specific standard.
- **Other Levee Projects** – These include projects that enhance flood protection beyond base level protection, subsidence control actions, developing improvements to the Levee Emergency Response Plan, and studying the risk of levee failure.

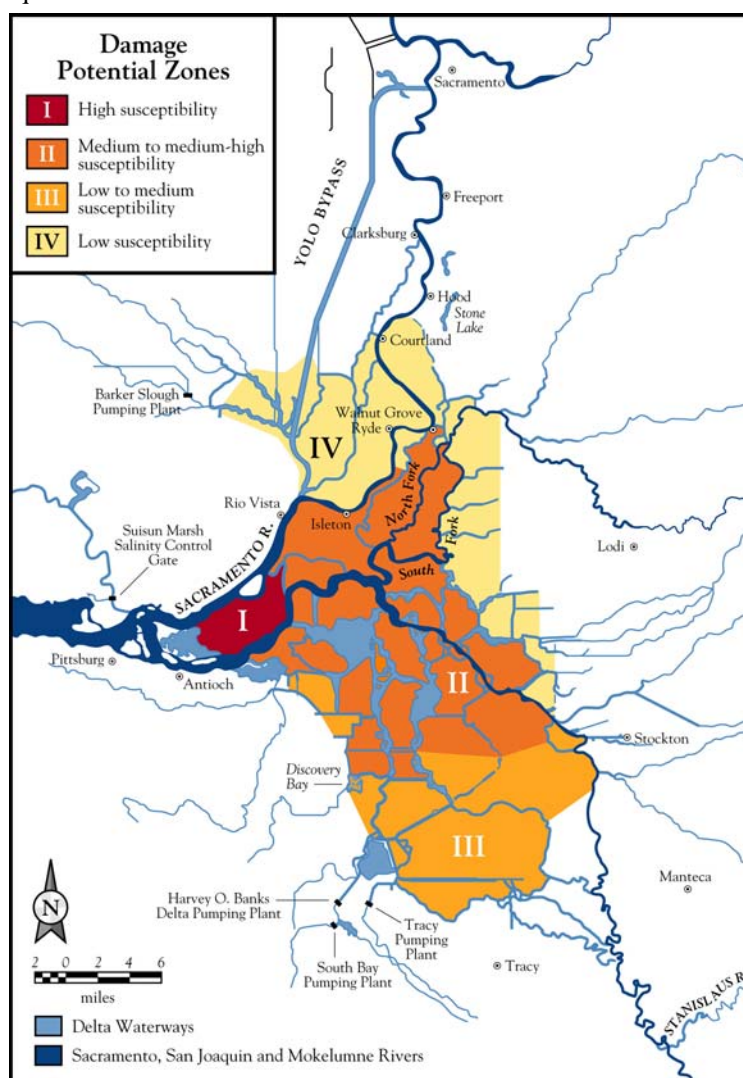
Seismic Risk: Many factors contribute to the risk of levees failure. The map at the right shows different levels of risk of seismic failure. Some parts of the Delta are subject to greater seismic risk because of the differences in the anticipated seismic acceleration, the different cohesiveness of the levees foundation and structural materials, the different potentials for liquidification in different areas and the differences in the hydraulic head on the levees.

The CALFED Science Program is developing indices of levee risk based on levee anticipated seismic acceleration and levee foundation geology, cohesiveness of fill material, location, and hydraulic head. These quantified performance metrics will help prioritize future levee investments.

Risk of failure due to a seismic event is greater in Zone I, the 20 miles of levee surrounding Sherman Island (see map at right). Zone II, the 301 miles of levee surrounding the islands within the Central Delta, is subject to a medium high degree

of susceptibility. Zones I and II are at greatest risk because these areas are subject to the greatest seismic acceleration; have the least cohesive foundation and fill materials; and have the greatest difference in water level between the surround waterways and the level of each island. In addition, the Delta Islands in Zones I and II have experienced more subsidence than others primarily because of the local soil conditions and depth of peat material.

Zone III and IV, the levees surrounding the periphery of the Delta, are subject to low to medium risk because they are less susceptible to seismic acceleration and have experience less subsidence.



Levees in some parts of the Delta are ore susceptible to failure due to earthquakes because of seismic activity, fill materials, and relative water levels.

Accommodation Space and Levee Force Indices

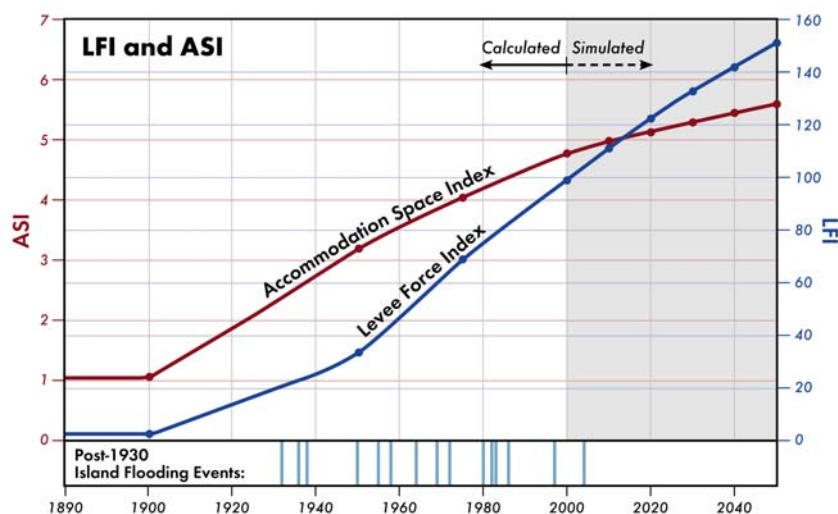
Indices: Two indices are being developed to evaluate historic, current and projected landscape changes in the Delta. The Science Program is developing an Accommodation Space Index that captures the consequence of

conjunction with other metrics to develop more definitive performance measures.

Based on the Levee Program's ongoing Risk Assessment and pending Comprehensive Program Review, it is expected that future levee investments will be made more strategically. Indicators like those shown at

right can help determine if those strategic funding efforts have been successful.

Miles of Levee Investment: The graph at right shows the miles of levees either maintained or improved through the CALFED Levee Program. These values indicate the nominal progress of the Levee Program.



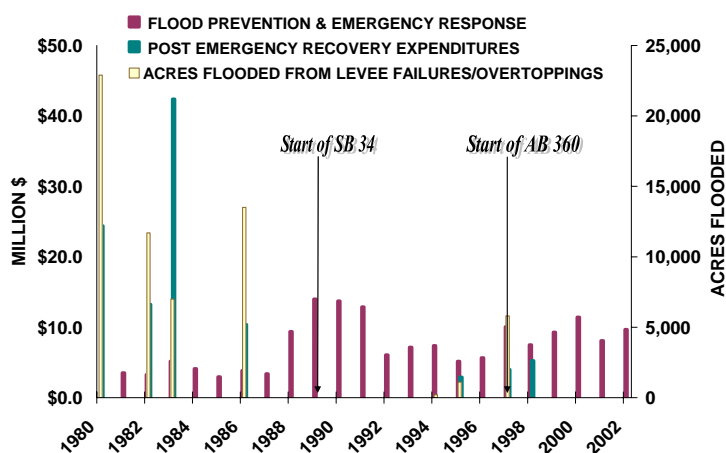
Preliminary work on accommodation and force indices show that levee risk has increased over time due to subsidence and sea level rise.

island subsidence and flooding. They are also developing a Levee Force Index that would be a proxy for the potential for levee failure and island flooding.

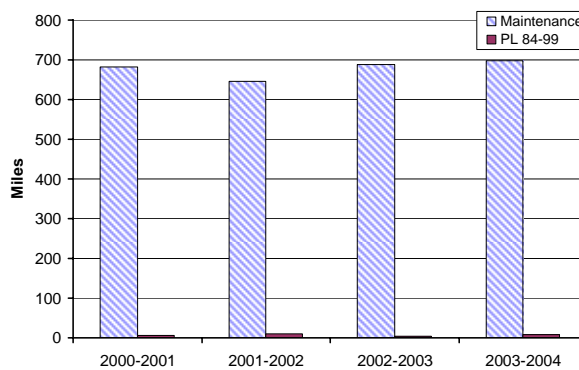
The figure at the lower right shows these indices, and associated risk of failure, tend to increase over time. This increase in risk is due to continued subsidence and sea level rise.

Flood Repair Costs: A primary objective of the Levee Program is to reduce flood risk and associated flood damages. The graph at right shows two indicators of flood damage – post emergency recovery expenditures and acres flooded from levee failure or overtopping. For the period of record shown (1980 through 2002) it appears that there has been a reduction in flood damage inversely proportional to the investments in flood prevention and emergency response.

Continued levee maintenance and improvement in investments are expected to continue to keep flood repair costs down. The extent and cost of repairing Delta floods indicate the degree to which levee maintenance and improvement investments have reduced flood risks. However, because many factors affect levee failure risk and flood repair costs, these indicators will be used in



Delta levee flood costs have declined as prevention costs have risen.



Levee accomplishments have included miles of maintenance and improvements.

Next Steps: This year, the unanticipated flooding of Jones Tract in the Delta has highlighted the issues surrounding the importance and stability of Delta levees. The Department of Water Resources is starting a multi-year risk assessment study to evaluate the potential risk of Delta levee failure. In addition, in response to this year's events, DWR has identified the need for a Comprehensive Program Evaluation of the Delta levee program, which may lead to future changes in strategy and approach for Delta Levees.

Meaningful performance measures will be an important aspect of these strategic studies. The Levee Program, in coordination with the CALFED Science Program is developing several levee performance measures.













Some of these measures will build upon the Accommodation Space and Cumulative Force Indices discussed above. The Accommodation Space and Cumulative Force Indices indicate that levee conditions are not static and that risk of failure is increasing at a significant rate as subsidence continues and the sea level rises.

The Program is also investigating a possible Levee Stability Index that would combine the concepts of the cumulative forces, the integrity of the levee structures, and systemic forces. This index may rate levee sections in terms of levee integrity reach-by-reach on a simple one to ten point scale by combining cumulative force and potential seismic acceleration on a given reach.

The Program is also investigating metrics that show the impact of levee failure on Delta water exports. When Delta islands are flood due to levee failure, the hydrodynamic conditions is the Delta cause rapid and prolonged salinity increase near the Delta pumps. The extent of these problems depends on the location of the flood and other factors.

Summary of Accomplishments: In the first four years of the Program, funding through the Delta Levees Subvention Program helped preserve Delta levees and make minor improvements while enhancing the Delta environment. The Levee Program has actively pursued research and pilot studies on subsidence and subsidence reversal. The Program has also moved forward in improving emergency response. The accomplishments of these activities are summarized below:

- 43 miles of levees improved to PL 84-99
- More than 700 miles of levees maintained through the Subventions Program
- Successfully reused more than 900,000 cubic yards of dredged material
- Created 15 acres of new tidal marsh habitat on Decker island
- Researched and conducted multiple pilot studies on subsidence reversal and improved emergency response
- Completed Phase I of Seismic Risk Study

Levee Program Budget Summary, in Millions \$						
Element Task	Appropriations for FY 00-04			Task Group	FY 00-04 Subtotals	Objectives Supported
	CALFED	Local	Subtotal			
Emergency Response	\$ 0.19	\$ 0.19	\$ 0.38	Science, Management, & Oversight/Coordination	8.16	  
Levee Subsidence	\$ 1.62		\$ 1.62			
Oversight and Coordination	\$ 1.68		\$ 1.68			
Program Management	\$ 3.92	\$ 0.51	\$ 4.43			
Risk Assessment	\$ 0.06		\$ 0.06			
Beneficial Reuse	\$ 0.34	\$ 0.45	\$ 0.80	Special Projects	30.54	  
Special Projects	\$ 29.74		\$ 29.74	Subventions	44.68	  
Subventions	\$ 31.18	\$ 13.50	\$ 44.68			
Subtotal - Environmental Water Account				\$ 83.37		
	Contributes to water supply reliability				Contributes to ecosystem objectives	
	Contributes to water quality objectives					